SOIL CONSERVATION

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NATIONAL DEFENSE AND THE C. C. C.

BY H. D. ABBOT [1]

ENROLLEES in the 392 Civilian Conservation Corps camps operating under the direction of the Soil Conservation Service are securing training and experience in many semiprofessional skills that are valuable to the defense program.

While all the 78,000 enrollees now working with the Service have received some background having defense value, 25,000 of them have had both instruction and on-the-job experience in special skills, such as truck driving, mapping, mechanics, construction work, or many others. The same is true of many thousands of ex-enrollees who have returned to their homes after serving enrollment periods.

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Emphasized in the pictures on the opposite page is the purpose of C. C. C. training, which is to make the enrollee an efficient workman and to help him become a more useful citizen.

1. Operating terracers, tractors, trucks and other heavy equipment gives specialized experience. Many enrollees become better fitted for jobs in private industry.

2. Vaccination comes early in camp life. Wholesome food, outdoor life, regular hours, and medical care make sound, strong bodies.

3. Mechanics, welding, blacksmithing, surveying, and other occupational trades are taught. Natural aptitudes are given consideration.

4. Many enrollees are from farms. They take home, and directly apply, what they learn in soil conservation.

5. Camp office work provides clerical training. Many enrollees become draftsmen and mappers; others, cooks and bakers.

Leaders and assistant leaders have learned to "handle" men, a skill which must be developed by those who wish to qualify as non-commissioned officers in the military service. The enrollees have learned to live and work together; they have learned the value and effectiveness of team-work, the necessity for and means of maintaining proper sanitation, and how to carry on construction with safety both to themselves and their co-workers. Through daily exercise, regular hours of sleep, and well-balanced diets, they are physically fit. These basic assets for national defense have all been acquired while carrying out what is in itself a fundamental national defense program—the conservation of our most essential resource, the soil.

Referring to the program during its first 7 years, J. J. McEntee, Director of the C. C. C., lists three major ways in which the Corps contributes to the defense program. First, there is the continuation and intensification of the program for building up the health, the physical strength, the morale, the general education and the civic usefulness of its young men. The second comes through the broad training and educational programs which instruct enrollees in proper work habits and discipline, and in skills useful in national defense as well as in industry. Third, and not the least important to national defense, is the contribution the C. C. C. enrollees are making to the various programs furthering the conservation of our national resources.

The Nation was shocked to learn of the poor physical condition of men called to the colors during the World War; equipping them physically so that they were able to become good soldiers took valuable time from military training. The C. C. C. faced similar problems. Many enrollees came to the Corps under-

Hard muscled and forward looking.

nourished and under-sized, and they had to be worked into the field programs on jobs they were physically capable of handling. A health survey of the C. C. C. by the Office of the Surgeon General of the Army, showed that normal weight expectations were not met by 25 percent of the enrollees. The same report shows that upon completion of the enrollment periods all but 4 percent had advanced beyond the minimum weight specifications.

Compulsory vaccinations for typhoid and smallpox have enabled over two million C. C. C.-trained youths to return to their communities protected against these dread diseases. Voluntary vaccinations for pneumonia begun in October 1937 at the suggestion of Johns Hopkins University, have been given to over 40 percent of the enrollees. Tuberculosis incidence in the C. C. C. is about one case per thousand, far below the expectancy for a comparable age group. Venereal disease frequency is exceptionally low. Teeth and eyesight of the C. C. C. boys are given both attention and care, with direct benefit to the general health and well-being of the individual.

From the standpoint of health alone, two million youths who thus far have served in the C. C. C. are in much better physical condition to carry out their share of defense service than are the average for their age group.

It is usual for laymen to think of military operations only from the standpoint of the fighting personnel, but any military technician will declare that it is equally important to have ready a highly integrated, trained civilian army to help service the armed forces in connection with food, equipment, communications and other facilities. At the present time and not counting the far greater number who received training in the first 6 years of the C. C. C., the 392 camps of the Soil Conservation Service, or only about 25 percent of the 1,500 C. C. C. camps, have in active service each day some 78,000 enrollees being fitted by work experience to take their place in this civilian army should the occasion arise. About one-third of these have voluntarily taken advantage of the opportunity for special training, both on and off the job, to prepare themselves to serve as repair men, surveyors, clerks, orderlies, draftsmen, blacksmiths, cooks, bakers, and many other types of specialists needed in the national defense program.

The training is not limited to mere theoretical instruction. It goes beyond theory. The task of the C. C. C. is to perform work, and advantage is taken to a high degree of the opportunity for on-the-job training, to learn by doing, in the training work. Theoretical principles are explained as a means of enabling the enrollee to work more efficiently and to understand more clearly the relationship of any momentary function to its associated operation. A considerable number of the C. C. C. boys go beyond instruction given in camps and enroll in correspondence courses given by colleges and private institutions, or attend night schools located in towns near camps.

Analysis of jobs performed by C. C. C. enrollees shows that they cover a field of 323 types of work, 262 of which are useful in national defense. The work programs in soil conservation camps offer opportunity for training in the more important of these work types—excavation, earth moving, road building, dam construction, the use of surveying instruments, mapping, use of explosives, clerical duties, equipment and tool operation, maintenance, and repair, as well as a host of other types of work required by defense activities. All leaders, assistant leaders and truck drivers are required to pass the American Red Cross Safety Course, knowledge of considerable worth from the point of view of national defense.

The accomplishments of the C. C. C. in furthering the program of soil and moisture conservation have been many and varied. Hundreds of thousands of check dams, thousands of terrace structures, thousands of miles of relocated fences, and innumerable other control measures have been constructed by the enrollees in benefiting some 12,000,000 acres of land. This work has a very real bearing on sound land use and the task of feeding troops and the civilian work army.

Direct benefits will result from the methods of more efficient crop production due to better land use and the elimination of farming practices which allowed unnecessary loss of the topsoil by erosion. The realization, which the demonstration of erosion control drove home, of how the large areas uncovered during the World War later brought dust storms and floods, with accompanying agricultural and social problems, may well be a major future benefit from the Nation-wide erosion control program with which the C. C. C. has assisted.

As a group, the 300,000 enrollees in camps of the Civilian Conservation Corps provide a formidable source of trained young men. Sixty-three central repair shops will be in operation this fall, and it is estimated that, by rotating enrollees, some 2,000 per year can receive high-quality automotive mechanical experience. In addition, by shifting boys assigned to the 1,500 camp garages, between 7,500 and 9,000 will learn the fundamentals of automotive maintenance. The latter group is, of course, in addition to 67,000 youths who, as operators of the 43,000 pieces of motorized equipment, help to keep their machines in running order.

The Army participates in the C. C. C. training program and its cooking and baking school prepares about 6,000 enrollees every 6 months for camp duty as cooks, bakers, butchers, mess stewards, and assistants. Approximately 2,500 enrollees serve as medical orderlies in camps and hospitals. During the last fiscal year, 50,000 leaders, assistant leaders, and truck drivers completed the regular first-aid course of the American Red Cross.

In the field, some of the roughest terrain in the Nation has been crossed in building over 114,000 miles of fire roads and trails, and in installing about 79,000 miles of telephone lines. The Corps has constructed over 7,000 horse bridges and some 36,000 vehicle bridges.

It is safe to assert that in the field work of the C. C. C. every enrollee has received some training of benefit to a program of national defense. The training in special skills, while it has been voluntary except for enrollees engaged in tasks requiring special basic preparation, has further prepared many thousands for effective service. By recent action the Congress authorized the President, in his discretion, and under such regulations as he may prescribe, to provide within the Civilian Conservation Corps such training of enrollees in noncombatant subjects essential to the operations of the military and naval establishments as he considers may contribute materially to the interests of the national defense. This action makes it possible for the Nation, at such time and in such manner as the President may decide, to utilize further the opportunities inherently present in the C. C. C. program for training in national defense.

TO PROMOTE THE GENERAL WELFARE

BY THE DIRECTORS OF THE SHILOH-O'FALLON (ILLINOIS) SOIL CONSERVATION DISTRICT [1]

WE, THE directors of the Shiloh-O'Fallon Soil Conservation District, believe that conservation of the soil is essential to promote the general welfare of ourselves and our posterity. We believe that organization of districts offers to farmers an effective medium for solving their problems of erosion control and land use.

Farmers in Shiloh and O'Fallon townships in St. Clair County, Ill., were not long in organizing a soil conservation district after the Illinois district law was passed in 1937. The Shiloh-O'Fallon district was the first to be organized under the law.

In the 1½ years since the district started operation, landowners in three adjacent areas have voted that their land be included through the same procedure used in forming the original district. The first addition, in July 1939, was 29,000 acres; the second, in January 1940, consisted of 2,500 acres; and the third addition, in May 1940, included 20,000 acres. The size of the district has thus been increased from 18,000 acres to about 70,000 acres; and the number of farms it includes has increased from approximately 200 to about 650.

St. Clair County, in which Shiloh-O'Fallon district lies, is the oldest county in the State, organized in 1790 and fixed at its present boundaries in 1825. In about a hundred years of farming, 50 percent of the land has lost over half of its topsoil.

The erosion problem is serious, though not so evident to the eye. The topography is generally rolling; about half the land is above 7 percent in slope. Gullies of all sizes are easy to find, but they do

[1] Theodore E. Reuss, Chairman, Fred Bergmann, H. J. Bechtlofft, Walter Luckner, Walter J. Mueller.

not account for nearly as much of the soil losses as sheet erosion does. The financial condition of the county is fairly good, there is no tax delinquency.

Over the county, farmers were not fully aware of the extent of erosion damage. The Extension Service had been emphasizing the erosion problem, and soil conservation demonstrations were only about 20 miles away at the soil conservation project near Edwardsville. But most farmers had too little knowledge of how badly erosion was depleting their own farms.

The establishment of the soil conservation district brought the immediate problem of acquainting *all* the farmers with the extent of erosion, the effects of it, and the methods for controlling it. With this in mind, we selected nine farms scattered throughout the district, which were representative of average conditions in the area. Each of these nine farmers immediately cooperated in planning a soil and moisture conservation program which he put into effect on his farm.

Each of the nine farms became a "textbook" for the use of the surrounding farmers in learning methods and the value of soil conservation. The "textbook" was easily accessible to the farmers and it was authoritative because it was "written" by a neighbor known as a good farmer and thereby recognized as a good "author."

The district immediately obtained the help of the Soil Conservation Service, which assigned three technicians and two assistants to help farmers within the district to plan soil and moisture conservation programs for their farms.

James W. Dunn was one of the nine farmers first selected by the district to develop soil conservation plans. In 1936 Jim Dunn had moved to a 90-acre farm that had seen a succession of all types of farming. A hundred years ago the farm was helping support the "wheat kings" of the community. In the early part of the 20th century, when crop yields declined, the pioneer family left the farm to a succession of short-term tenants whose parade across these acres left enlarging subsoil areas and lateral ditches gnawing away from a creek that bisects the farm.

The farm changed owners just before Jim moved to the land. The new landlord, who had pioneered in the use of limestone and phosphate on another farm, started liming the soil. By 1938 corn yields were boosted from 10 bushels per acre to about 30 bushels; wheat yields showed no change.

He was interested in improving his farm and had investigated the work of the University Extension Service and the Soil Conservation Service. He was anxious to take advantage of the technical advice extended to him by the Soil Conservation Service technicians to set up one of the first soil conservation demonstrations in the district. So he spent a good deal of time with the agronomist and engineer.

The soil conservation survey showing slopes, soil types, and amount of erosion was the basis of their discussions. The technicians—locally known as "the district men"—explained the unfamiliar symbols on the map; they taught Jim to "know" his farm. He learned the areas that are least susceptible to erosion, the areas where erosion has done the most damage, and where it hits the hardest. He learned the crops that can be grown with least danger of erosion and those that "aid" erosion and should be confined to certain areas.

The "district men" got Jim's ideas on how he would like to operate his farm. Then, carefully, thoroughly, he and the district men worked out a complete plan of conservation operation for his farm. "This course of development fooled nobody," says Jim, "but it did give me some pride in planning my work, and it developed a vast respect on my part for the thoroughness of the research and experience on which such planning is based."

The farm plan that was formulated furnishes a balanced livestock production sufficient to provide a modest income. The plan calls for 4-year rotation of corn, wheat, sweetclover pasture, and wheat with sweetclover catch crop in four 13-acre fields. The fields are laid out on the contour for 1940 operation, and 3,800 feet of terraces are to be made in one field where the terrace outlet, constructed in 1939, is sufficiently seeded to grass. One of these terraces serves as a guideline for contouring the fields. Two alfalfa fields of 5 acres each provide hay. Permanent pasture has been increased from 6 to 17 acres.

Four acres of unpastured timber will remain, with wildlife food provisions nearby. The number of quail has been increased under the game control plan of the district. The cooperation of the State Department of Conservation has been very helpful in this connection. The lateral gullies from the creek are to be planted with black locust and wildlife shrubs.

All these details of Jim's proposed plan of operations are incorporated in tabular and written form easily understood and serving as the basis for an agreement which he signed with the district.

He attended a meeting of the University Extension Service where soils and crops were discussed and learned how to work out the plant-food balance for the new rotation. He found that, with the addition of limestone and phosphate, the plant-food content of the soil should increase.

"One year's operation under the district agreement has shown an increase in corn production of about 15 bushels per acre, and wheat production is doubled," Jim now declares. "No troublesome gullies appeared in the last wheat harvest as they had in previous years."

The farm plan is not perfect and probably is not completed. The rotation requires that some corn be cut to make way for wheat. A solution to this problem would be a spring green grain comparable to wheat in value and as a clover nurse crop. Spring barley adapted to southern Illinois would be useful. This problem is not confined to this farm, however, but is general in the area, and has been intensified by the coming of the combine which does not work well in oats. The farm plan develops more roughage than present livestock consumes, and there is some waste. A logical solution here may be to increase livestock numbers carefully and to harvest a sweetclover seed crop.

Nine "textbooks" on soil conservation planning similar to that for the James W. Dunn farm were developed over the county. After the final plan was made and agreed upon by the respective farm owners and operators and the district, small groups of farmers were invited to visit the farms where the planned programs were discussed. During these small tours, farmers in the district began to get a "working" picture of the objectives of the district.

In assisting farmers in the formulation of farm conservation plans, various methods of procedure were tried out in the early stages of district undertaking. At first, each of the three Soil Conservation Service men assigned to the district visited all the farms to offer advice in his special field of knowledge. This was excellent in the interest of thoroughness and was warranted in the early work, but soon it became apparent that such an arrangement was too slow to permit rapid advancement of the district plans. Furthermore, each technician soon became a conservationist so that it was not difficult for him to represent the others' specialties along with his own.

Under present arrangements, all applications for assistance received are held until the next directors' meeting. Then at the meeting we, the directors, approve the applications in the order of the date they were received, and assign each one to a conservationist. A personal letter, explaining in general the soil conservation program and the facilities available, is sent by one of us to each of the applicants. Usually the applicant has had the opportunity at some small meeting to go over a land-capability map of his farm and he has already a general idea of the proper land use for his land.

When the conservationist makes his first call on the farmer, together they go over this map and attempt to apply their combined knowledge to the operation of the farm. At this time the conservationist obtains all possible information relative to the farmer's business and his general economic condition. The farmer, in turn, learns in more detail the operation of the district. On this first visit the conservationist points out where possible practices might be applicable and practical, and, if the farmer is receptive to these suggestions, plans are made for the necessary surveys.

In the process of formulating the land-use plan, the work phases become apparent to the farmer. He is asked to assist in the surveys for terraces, strip cropping, structures, etc. The farmer's participation in surveys, etc., not only gives him a better idea of his plan, but also reduces the amount of time that must be spent by the district men on the farm.

Finally the plan reaches the stage where the land use for the farm is decided upon. Future field arrangements and crop rotations are outlined, cost of installation of various practices are determined, livestock and market facilities have been discussed, and the time for execution of various parts of the program is agreed upon. The cooperative agreement is then drawn up and signed by the owner, operator, and by one of the directors. The completed plans are turned over to the two assistants. These men are responsible for giving the farmers enough assistance for putting the plans into effect. As more agreements have been signed, this matter of assistance has become a real problem. With little more than a year of work behind us, it is difficult to venture a solution to the problem, but several things are apparent. First, we must hold more group training meetings where several farmers may be shown how to do a certain thing. Too, the conservationists will no doubt find it necessary to drop their planning work during the rush seasons and assist in the execution. We believe our most important task is putting the plans into operation, for plans on paper will not control erosion in the fields.

The problem of a general lack of knowledge of what soil conservation means was not solved by the nine "textbook" farms. Some farmers have only the plugging of gullies in mind, others are interested only in a pond, and still others are concerned about the establishment of woodland and wildlife areas. After the district had been in operation for only a short time this problem became very noticeable. We

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THIRTY YEARS OF VERTICAL FARMING

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snow of 1940, indeed, even those caused by the rains that had fallen since the last cultivation of potatoes in July 1940.

Some fields that had a soil depth of more than 3 feet to bedrock in 1908 had less than 6 inches over about a fourth of their area in 1940. On one farm that was terraced this year, the soil had been washed so shallow that the terrace channel had to be blasted through 1 to 2 feet of limestone rock in order to get the proper depth and gradient. In an adjacent sloping field on a farm lying above this terraced field, where the potato rows all ran straight downhill, it was found by measuring the size of the washes in the furrows since the rain of July 25 when 1.13 inches fell, that 35 tons of soil per acre had washed down into the strip of vegetation along the farm boundary or on across the lower farm. The total erosion from this upper field had averaged one-fourth of an inch of soil per acre for the rains that fell between the last cultivation on July 21, 1940, to September 1, 1940, and approximately an inch for all the rains and melting snow of 1940 up to the same date.

In another adjacent field, where potatoes have been grown almost continuously for several decades, I walked a distance of 550 feet along a shallow gully that had cut down to bedrock. Adjacent to this gully, the soil, or rather the subsoil that was left after years of erosion, ranged from about 2 to 4 inches to bedrock along most of the distance.

Here was a field where the combined soil and subsoil depth was at least 2 feet 32 years ago, in which the average depth of subsoil—the original topsoil is all gone—is less than 12 inches deep today. Some of it is too shallow to plow now; most of it is too shallow to terrace; all of it will be too shallow to cultivate with a few more years of use without protection. In other words, more than a foot of soil and subsoil, amounting to some 16,000 tons (32,000,000 pounds) per acre, has been unnecessarily wasted in this field over a period of about 25 years of cultivation.

I said "unnecessarily" wasted. It would not be quite precise to leave it that way, because people were not thinking about erosion in this section, as in most other parts of the United States, and so until recently they were doing little to stop it. On 123 farms, comprising 18,000 acres, in the Aroostook soil conservation demonstration area, erosion has been so controlled or reduced with the aids of terracing, contour cultivating, strip cropping, crop rotations on the contour, retirement of excessively steep slopes and slopes with soil worn too shallow to the permanent protection of trees or grass, that people are beginning to realize that such controls must be recognized and made a part of good farm practice.

I am convinced that they will become a part of good farm practice. Interest is spreading, State and Federal agencies are working together to help farmers with the soil conservation problem. I even ran into potato machines that were being worked on with the view of effecting adjustments that would make them work better on terraced land.

For a time there was fear that potatoes would rot because of the water conserved in contoured rows, but that fear appears to be fading in the light of experience. In 1938, a rather wet year, contoured potatoes on 19 of 32 farms in the Aroostook project produced an average of 117.6 bushels of good-quality potatoes per acre, as against 107.2 bushels for up-and-down the slope potatoes on the other farms. Of the contour-cultivated potatoes, 66 percent of the samples showed rotten tubers; of the non-contour-grown potatoes 72 percent showed rotten tubers.

Accordingly, the objections are being met, the fears are fading out, and conservation is spreading. It must spread; it must go fast; it must quickly get away from vertical agriculture—up-and-down the slope farming—if the rolling lands of Aroostook County are to continue in use for clean-tillage agriculture. More organic matter must be worked into the soil, and the best way to meet this acute need is to work more legumes and grass into the rotations, and, undoubtedly, the best way for this to be done is for the farmers to raise more livestock.

All this is intended to show what can happen to land if those natural laws that man cannot repeal or amend are overlooked too long; and how man can advantageously adjust his ways of using the land to the ways of nature—adjusting land use to the ways of flowing, biting water that bites harder and deeper into the living flesh of productive fields when man fails to cooperate and get along with nature.

Also, a lot can happen to land within a generation.

ECOLOGY AND LAND USE

BY EDWARD H. GRAHAM [1]

Ecology is not so much a special branch of biology—in the sense that genetics or the physiology of nutrition are special branches—as a way of regarding animal and plant life.—A. G. Tansley.

AULUS, the Roman, spoke proudly when he announced that at last they knew malaria was caused by the night air. Then, like other intelligent Romans of his day, he ordered all the doors and windows of his home tightly closed from sundown to sunrise to exclude the "pestilence that walketh by night." Little did the Romans realize that 1,500 years would pass before the truth would be known about malaria—that the disease is carried by the *Anopheles* mosquito. Yet of all the plagues of human history malaria probably has taken the heaviest toll of human lives. For twenty-five hundred years it has persisted throughout many parts of the world. Before the rise of Rome it was recognized as the most deadly enemy of the Athenian Empire, and if she had conquered malaria, Athens would have ruled the world. Ancient Rome lost more soldiers to malaria than to her enemies.

The Roman authorities tried diligently to discover the cause of this plague, and came near the solution, for they found a relationship between the disease and the night air, and closing their homes at night was correct procedure. But the next step in man's knowledge of this malady was delayed 15 centuries until someone began to look for further relationships. Even then, long, patient experiment was necessary to learn the baffling fact that infective transmission requires a certain interval of time, that only a few of more than 100 species of mosquitoes can transmit malaria from one person to another, and that of these it is the female alone which carries the disease.

What we know now about malaria we have learned by attempting to deal with all factors affecting the situation, instead of considering a single factor to the exclusion of others that might have an equally important influence. This is an example of ecological thinking.

Some day we shall look back tolerantly upon the time when bounties were paid for hawks and owls, while men lamented the presence of mice and snakes, upon which such predatory birds, if unmolested, effect some measure of control. Shall we not knowingly shake our heads when we recall the widespread efforts of those who so enthusiastically stocked with game habitats unfit to support it, and planted fish in streams and ponds where there was no likelihood of their survival? Game laws not ecologically sound will seem absurd, for the relationship between animals and their environment will be better understood. Even now we know that high populations of deer in the Northeastern States have been possible because food was supplied by second growth browse that sprang up where virgin forests were cut away, and that as this browse matures into forest trees it will no longer be good deer food, and the deer will starve. When that happens the most stringent protective laws will be unable to preserve the animals unless management methods based upon a knowledge of existing relationships are first applied to the land.

In the program of the Soil Conservation Service a fundamental concept is that of a coordinated approach on the part of several technical fields toward the solution of a common problem—soil erosion. This concept is based on the relationship of the land owner to his environment—the farm which he operates and the market which absorbs his production. A sound agricultural program will result in a balanced condition where crops and soil, rainfall and run-off, birds and insects, yield and market, and all other components of the farm as a habitat, are in adjustment. In this light, prevention of soil erosion on agricultural land, like every conservation endeavor, is fundamentally an ecological problem.

That farming involves many ecological patterns is illustrated in the following example: For a long time agriculturists advised against the use of a permanent ground cover of herbaceous vegetation in southern California pear, avocado, and citrus orchards. It was

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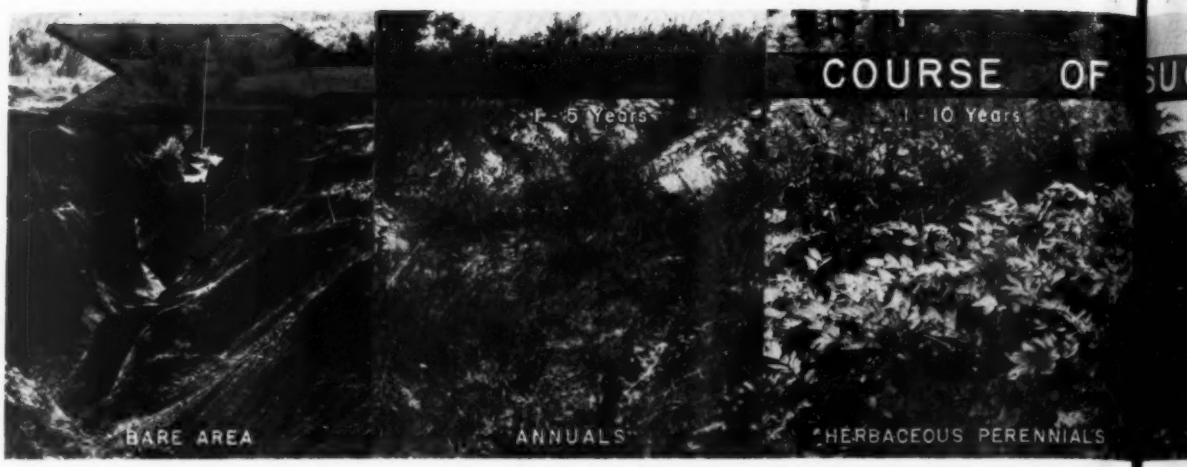


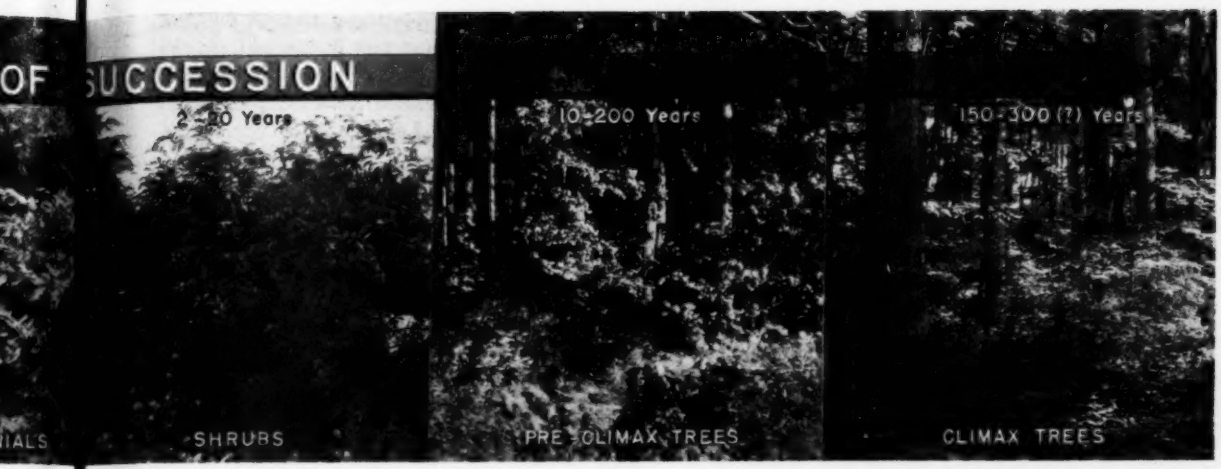
believed that a ground cover of vegetation sheltered field mice and other rodents which ate the bark and roots of trees, provided protection to injurious scale insects, increased irrigation costs by absorbing water, and, through competition for nutrients, reduced fruit yields. However, orchards maintained for a great many years in permanent cover of herbaceous perennial legumes and grasses have demonstrated that yields are not reduced under this practice. On the contrary, packing house records show yields from these orchards to be much higher than the average; they also bring better than average prices. Furthermore, operation and irrigation costs are low. Irrigation is accomplished by flooding from furrows constructed across the slope, the water being spread by the dense plant cover which, by providing infiltration into the soil in place of rapid run-off, actually conserves water.

Flood irrigation in itself is an effective aid in controlling gophers and other small rodents, and the cover of herbaceous vegetation supplies food for mice that no longer are forced to feed on the trees. The ground cover harbors predaceous insects and ground nesting birds that help naturally to combat insect pests. Permanent cover likewise obviates annual seeding, practically eliminates cultivation costs, prevents interference with feeder roots of the trees located near the surface of the ground, and prevents soil erosion. Thus the invaluable soil resource is permanently protected, and harmonious relationships are established among the biological components of the orchard community which it is to man's advantage to understand and maintain.

In farm woodlands man profits by knowing something of ecology. The snowshoe hare of our Lake States forests is often blindly charged with intolerable injury to young trees. This is especially true on clean-cut or burned-over areas where natural reproduction results in very thick stands. Now the hare is a highly cyclic species, with "highs" of large populations occurring at 10-year intervals. When the hare population is at its peak the animals eat, girdle, or prune the young trees until the stand is so open that they may be easily seen by predatory mammals, owls, and hawks. The hares must then retreat to thicker stands for protection. They may return at intervals of a few years whenever the trees have again thickened enough to form protective cover, and may thin out the stand recurrently until the bark becomes too thick to be palatable. Instead of being an unmitigated evil, however, the opening of the stand in each case permits the remaining trees to recover from their stunted condition, helps to reduce the fire hazard, and minimizes insect damage.

In northern Minnesota the value of the thinning operations of the snowshoe hare is set at a high figure. Furthermore, foresters have learned that in this region plantations of trees show a much higher percentage of survival if the plantings are thin, in which case they do not provide escape cover under which the snowshoe hares can work, and that there is minimum damage if plantings are correlated with "lows", in the population cycle of the hare.

Small forest animals, such as shrews, moles, mice, and chipmunks, have long been listed on the debit side of the forester's ledger, because they eat seeds and damage tree seedlings. Yet, recent studies show that small animals inhabiting the forest floor eat an astonishing number of insects, many of them larval forms of species highly destructive to mature trees.



The insect-destroying values of these mammals may be even higher than the values of insectivorous birds, for the number of such animals per acre is greater than the number of birds, and, unlike most birds, the mammals are resident and usually active throughout the year. It is conceivable that, without forest animals, we might have no forest at all.

The older forest plantations of continental Europe, planted to pure stands of spruce or pine, once were lauded for the neat appearance of row after row of similar trees. Today we know that soils are depleted under a uniform type of forest cover, and that disease is prevalent because it can spread more easily than in mixed stands. In such European forests insect damage is so widespread that bird boxes are being installed in an attempt to restore artificially some semblance of the biological balance which was lost by man's failure to think ecologically.

To the ecologist there is real significance in the adage that man must learn to work with nature, not against her. But the ways of nature are not easy to learn. The following example illustrates this: If a coyote is observed to kill a lamb a fact is established, namely, that coyotes kill lambs. Since lambs are desirable, the obvious conclusion seems to be that coyotes must be destroyed if lambs are to survive. This is the simplest deduction—but it does not represent ecological thinking. The ecologist wants to know how the destruction of coyotes affects other things. Unfortunately, much more money and effort have been spent in destroying coyotes than in attempting to learn the place they occupy in the biological complex of which they are a part. Nevertheless, we have learned enough about their food habits to know that they live on rabbits and various small rodents to a substantially greater extent than on lambs.

Of rabbits and rodents that live throughout the range of the coyote another isolated fact is apparent—rabbits and rodents eat grass. This simple relationship seems also, to interfere with an activity of man, for cattle and sheep likewise eat grass. The obvious conclusion is that rabbits and rodents should be destroyed to preserve food for livestock.

But it is apparent that the destruction of coyotes and the simultaneous destruction of rodents, on which coyotes naturally prey, is illogical. For if man did not reduce the number of rodents by poisoning, the coyotes, finding their natural food more abundant, might feed more upon rodents, and less upon lambs. There would then be less need to kill coyotes. Also the rodents thus naturally reduced in numbers, would compete less with livestock for food, and man could put to better profit much money he now spends in rodent and predator control.

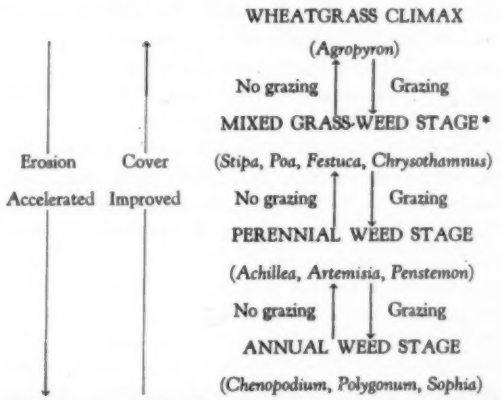
Of course, practical management of wild animals in relation to range land is not as simple as the writing of the preceding paragraph, but a consideration of the interrelationships stated is a simple example of ecological thinking. From this knowledge the ecologist wants to go forward—to learn more about other relationships between coyotes, rodents, man's domesticated animals, and the vegetation of the range, until he discovers what factors, if any, must be modified to attain the biological balance that will provide the maximum return from the land consistent with its best use and long-time productivity. It may well be that regulation of livestock grazing to the carrying capacity of the range may prove to be the management measure that will keep both rodents and their predators under control. Proper grazing is a way of working with nature and may upset the desired balance less

than any other kind of disturbance man might introduce. Ecologists might profitably be employed to learn more about these relationships.

Today we hear more and more about ecology. We hear that conservation of resources is attainable only if founded upon ecological principles; that many subjects, such as geography, are properly taught only when treated as human ecology; and that the tumultuous unrest of the world today exists because man has held more to political than ecological tenets. Such ideas are based on the conventional definition of ecology—the science of the relation of living things to their environment. The concept of ecology as a science, however, connotes a language of unfamiliar technical terms and a knowledge available only to the specialist. But in a broad sense, ecology is much more a process of thought than a science, and as such is useful to a great many persons. To think ecologically requires only a knowledge of facts and an ability to relate them correctly. Anyone can utilize this type of reasoning, although to arrive at a solution in specialized fields a trained ecologist may be required to interpret accurately the facts and place them in their proper relation to each other.

The ecologist finds practical as well as theoretical usefulness in the concept called succession. This concept contends that primeval vegetation undisturbed by man, whether it be forest, grassland, or desert, is in essential equilibrium with the climate. Such vegetation is considered climax for the region and will perpetuate itself. If the climax vegetation is removed from an area, it is not reestablished until several different plant communities have successively occupied the area, each more like the climax type than the preceding. For instance, if a virgin hemlock-hardwood forest is destroyed by lumbering, it is not a stand of young hemlock and hardwoods that immediately begins to replace the cut-off trees. Instead there first springs up a growth of annuals, usually widespread weeds. A few years later this is succeeded by a cover of herbaceous perennials. Still later shrubs invade the area and finally, after many years, trees such as cherry, aspen, and birch appear. In the course of a long time, these trees are gradually replaced by climax species of hemlock and hardwood, to produce eventually the type of forest originally on the land. Of course, many kinds of disturbance, as fire, cultivation, and erosion, may modify this succession, and man's activity ever tends to prevent its progress; but it is an ecological law that the vegetation of a disturbed area attempts incessantly to return to its original climax composition that is in equilibrium with the climate of the area.

Anyone familiar with the stages through which a given succession must progress in reproducing the climax type, can tell from the plant cover of a disturbed area how far it has developed toward duplication of the original vegetation. Likewise, if he watches an area over a period of years, he can determine whether it is progressing toward the climax or retrogressing toward a lower stage in succession, as it does under misuse and erosion. Man is only beginning to learn how to apply this principle to his daily activities, although a generation ago ecologists learned that in the wheatgrass grazing land of central Utah the species of plants increasing on the range tell one of two stories. If plants appearing on the range belong to a stage lower in succession than the predominant vegetation, the range is deteriorating, a condition brought about by misuse, as overgrazing; if invading plants belong to a higher successional stage, then the range is improving. The situation may be diagrammed:



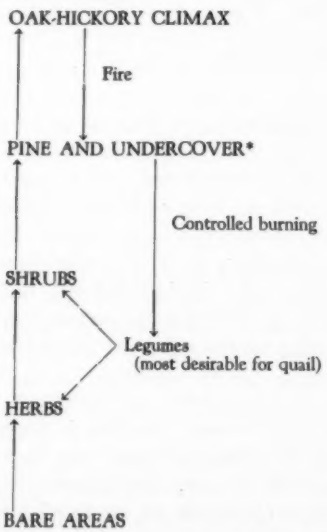
*Because the variety of palatable plants makes this stage the most desirable for grazing all classes of stock, the range manager will attempt, by proper stocking, to maintain the range in this condition.

No amount of money spent on weed control when the range is in the annual weed stage, or even in the perennial weed stage, can successfully eliminate weeds. The only economic way to control weeds is to remove the cause of their appearance, in this case overgrazing. When grazing pressure is relieved, the natural process of plant succession will inevitably replace the weeds with more desirable plant species—and at no cost to man.

More recent studies of the vegetation of abandoned fields in western Nebraska indicate that it is possible to determine, from the plants growing there, exactly how many years ago a particular field was last cultivated. Consequently, an ecological knowledge of plant communities and succession makes it possible

not only to understand something of the past history of a parcel of land, but to predict its future as well, which, in the last analysis, is one of the greatest tests of the usefulness of any human discipline.

That man, by proper management, can maintain native vegetation in a condition suitable to his needs, that he can "arrest" succession, is a comparatively new thought. It would seem to be valuable in range and pasture management, forestry, and nearly every agricultural practice dealing with plants except the cultivation of annual crops. The biologist has been quick to utilize this principle. For example, game managers in the Southeast have learned how to maintain beneath open stands of longleaf pine a heavy undergrowth of native leguminous plants invaluable as food for the bobwhite quail. This is done by carefully controlled, light, periodic burning of the forest floor. Such a practice also aids in maintaining the forest of longleaf pine, for burning encourages reproduction of this species, and the resulting heavy herbaceous vegetation may well provide better grazing, although little attention has yet been given by ecologists to these further relationships. The result of burning as a quail-management practice may be diagrammed as follows:



*The stage commonly dominant for the "Southern Pine" region, due to recurrent, uncontrolled, heavy burning, even prior to the advent of white men.

In any program aimed at the proper use of land, ecological thinking is a prerequisite. Interrelationships of plants, animals, and man with the physical environment, the trend of plant succession and how to make use of it, and attention to many minor axioms of ecology must be considered, else man pushes a wagon with the brakes on. The attempt of the Soil Conservation Service to apply use-capabilities to types of land is of interest in this regard. This scheme recognizes a relationship between several factors such as soil type, degree of slope, vegetative cover, erosion, and the best adapted land use. To maintain some semblance of balance between use and conservation of land, it is generally true that disturbance of the soil must decrease as the slope of the land increases. Therefore, on the steepest and most erodible slopes a protected permanent cover of vegetation, as forest or prairie sod, must be preserved. On slopes less easily disturbed, carefully managed pasture may prove a wise land use. Still gentler slopes may be cultivated with careful application of soil-conserving practices, including, perhaps, long periods in grass rotation, while constant disturbance may be safe on the most level and least erodible areas. The designation of specific land-use capabilities for various types of land according to a consideration of all their physical properties represents a concrete application of ecological thinking.

Another matter in which the ecologist is interested is what happens when non-native plants or animals are introduced into a region. In older countries, such as England, some sort of biological balance has been attained, but in newer countries the consequences of introductions are not easily predicted and may present extremely complicated biological interactions. For example, some zealous gardener, who wanted to make Hawaii even more beautiful than it was, introduced there an ornamental tropical American shrub, *Lantana camara*. In its home this plant "knows its place" but, as we shall see, in Hawaii it took full advantage of its new association.

Some time before the introduction of this shrub, turtle doves from China had been brought to Hawaii, and Indian mynah birds also were introduced. Unlike natives, these two birds fed heavily upon Lantana fruits. The aggressiveness the plant displayed in its new habitat plus the capacity of the exotic birds to distribute the seeds combined to make the plant a serious pest in parts of the islands devoted to grazing. But there is even more to the story. Before the mynahs were introduced, the Hawaiian grasslands and young sugarcane plantations had been severely damaged by armyworm caterpillars. When the mynahs came, however, they helped to keep the armyworms under control. Meanwhile someone got the idea that certain foreign insects would check the spread of Lantana by eating the seeds. Consequently, insects were introduced. As predicted, they destroyed so much seed that the

Lantana began to decrease. Then the mynahs, deprived of Lantana seeds for food, likewise began to decrease. This resulted in a recurrence of armyworm outbreaks. Furthermore, many of the places now vacated by the Lantana shrub became occupied by other introduced shrubs, even more difficult to eradicate than Lantana. Here is a lesson about the reckless introduction of exotics, for the result in this instance was an ecologically unbalanced situation becoming for man a long difficult task in bringing about some sort of desirable stabilization.

In the United States much damage has been caused by exotics, such as the chestnut blight, Hessian fly, cotton boll weevil, and weeds, most of which are Eurasian plants. Of course, native species may also cause trouble, as do the grasshoppers of the Great Plains. In defense of introductions, one might argue that many of the cultivated crops of the United States and nearly all of our domesticated animals are non-native species. For the most part they survive, however, only when tended carefully by man. This discussion is not intended as a statement to the effect that introductions are necessarily harmful, but rather to emphasize the fact that great care must be exercised in tampering with the ecology of an area, and that it is imperative for his well-being that man think ecologically as well as in terms of simple cause and effect relationships.

We live in an environment of many facets related not as single pieces, but as a mosaic, the pattern of which is not appreciated at first glance but must be seen in different lights to disclose its true design and its real worth. Thus it is easy for man to look to immediate gain, forgetful of the long-time advantage. But to achieve a lasting economy he must consider all the implications of his operations on the land. Might it not have been possible to prevent the passage of homestead laws that once encouraged families to live on land incapable of supporting them? Might the Great Plains have been spared the devastation that resulted from wholesale plowing of the sod with no regard for consequences? Could drainage that exposed land worth less than the cost of drainage operations, and many other activities we now regret, have been avoided? Is what we plan today equally unwise, or are we prepared to consider all the interrelationships our actions might involve, and act upon that knowledge? It is not an easy responsibility. Ecological thinking is one discipline to aid man in dealing with the world in which he lives, and one to which, in the future, he must be forced more and more to give attention.

TO PROMOTE THE GENERAL WELFARE

(Continued from p. 127)

discussed it with the county farm adviser and the Soil Conservation Service personnel. We decided that a strong educational program was urgently needed.

Exhibits and pictures were shown wherever possible. A news article on the activities of the district has appeared in the local papers every week since the district office was established. The Extension Service, organized farmer groups and committees, the State Soil Conservation Board, the Illinois Department of Conservation, the Farm Security Administration, and the Agricultural Adjustment Administration have all cooperated with the district in this effort to acquaint people with the district program. The result of this cooperation is a better understanding on the part of personnel directly assisting the district of all programs in the county that are sponsored by various agencies. It has also encouraged farmers to utilize the opportunities afforded by these agencies, and thus the agriculture is improved.

There is one thing that the 1½ years' work has made us sure of—that the district program is *sound*. Farmers participating in the district program learn soil conservation by their own efforts. They take pride in displaying their work, and are developing a real sense of appreciation of the results of that work.

A trip over the district and talks to other cooperators bring forth the same expression of belief in soil conservation, admiration for the district's work, and the vision of fuller, more enjoyable farm living. Unheard, unseen, but instinctively felt, is the deep satisfaction of pioneering on something that is vital and far-reaching for the welfare of the people and the land.

The importance of crop rotations in saving soil is set forth by the Arkansas Experiment Station in its Fifty-First Annual Report. Under continuous production of corn on Clarksville silt loam with a 6-percent slope, soil was lost at the rate of nearly 5 tons per acre annually. With a 3-year rotation of corn, winter oats, and red clover, the ground was well covered about 85 percent of the time and the loss of soil averaged about one-third of a ton per acre annually. What is more, the rate of loss has been increasing with continuous corn and decreasing with the rotation of crops.—A. T. Semple.

SOIL EROSION IN GREECE

BY CONSTANTINE I. NEVROS [1]

AN INTERESTING article entitled "Poor Man's Cow" on the position of goat breeding in Greece appeared in SOIL CONSERVATION for October, 1938. The goat has many virtues, but it should not be forgotten that the goat is the animal responsible for the extensive destruction of Greek forestry, the consequent erosion of the soil of Greece, and the barren and arid character of so much of the country.

The history of soil erosion in Greece is not without interest. In classical times large portions of Greek forests were felled to provide lumber for the construction of Athenian triremes, but even before that time, according to Plato, forests were destroyed and in mountainous regions were often razed for various reasons. Even so, the phenomenon of erosion was of a rather local character. The goat was not so important as a destroyer in those days. The nomadic stock breeders of antiquity had at their disposal, in a country more or less thinly populated, sufficient valley land to allow them to remain in the lowlands.

The serious destruction to Greek forests appears to have started during the Roman invasion in Macedonia. The Greeks lost their fields in the fertile plains, and took refuge in the mountains where they were forced to become stock breeders. The goat was to them the ideal animal because it can feed on twigs and shrubs unsuited to sheep and cattle. The descendants of these refugees appear to be the modern nomad Greek mountaineers.

The Turkish domination of Greece had a similar effect. On a larger scale than during the Roman occupation, the Greeks lost their fields and took refuge in the mountains where stock breeding was the only possible occupation. Arboriculture was out of the question because cultivation of trees requires a high agricultural standard and sufficient means of transport to markets.

The "poor man's cow," now in large domesticated herds, set about its destructive work. Every shoot and twig was nipped off as food as soon as it showed. When the large trees died they were not replaced and the hillsides gradually became bald spaces at the mercy of the winter rains. Erosion followed the dainty cloven-hoofed prints of the goats.

Owing to the country's mountainous formation, the destructive effects of erosion in Greece were unusually rapid. Without vegetation the sloping sides of the mountains were incapable of holding together the soil, which was carried away by the torrential rains to the plains, which in turn became flooded marshes in the spring.

Few efforts were made to check the deadly work of erosion. In the Greek islands and along the coast, where climatic conditions favoured the production of valuable agricultural products such as currants, olive oil, and fruits, terraces and drains were built. The restricted areas of plains available in the islands did not permit the abandonment of the soil. It was found possible to hold it together by terraces up to the summits of the mountains.

Only within recent years, and especially under the present Government, did Greece perceive the danger and take steps to combat it. Today a systematic program for planting trees on the slopes of mountains and channelizing the torrents is being carried out.

The goat was recognized as the evil genius of erosion in Greece, but the problem was not an easy matter in view of the income derived from goat breeding. This is estimated to be about 738,000,000 drachmas [100 drachmas equals about $0.70] annually, while the aggregate value of goats in Greece is estimated in the neighborhood of 1,600,000,000 drachmas. Some other means of livelihood must be found to replace the goat. Their mountaineer owners could not readily be absorbed on the plains.

The present National Government, after careful investigation of the question, seized the problem by its curving horns and passed the Compulsory Law No. 875 of September 28, 1937, by which it is provided that the goat will disappear gradually within a period of 10 years from those regions where it is injurious.

To help in this great work, the Institute of Chemistry and Agriculture, "Nicolaos Canellopoulos," organized a special research department to deal with soil conservation. The department, besides its purely scientific work, has issued a soil map of Greece,[2] and special educational pamphlets on the systematic use of the soil.

The Greek soil, if cultivated systematically, can feed double the number of the present population (about 7,200,000). To do this, however, every square inch of soil must be preserved.

[1] General technical director of a chemical products and fertilizer company, Piraeus, Greece.

[2] The plates for Crete, Euboea, Zante, have already been issued; the plate for Attica is being printed.

ACOMA AND LAGUNA INDIANS ADJUST THEIR LIVESTOCK TO THEIR RANGE

By DEWEY DISMUKE [1]

ACOMA and Laguna Indian pueblos in west-central New Mexico recently made the last in a series of livestock reductions totaling 63,000 sheep units needed to bring their 388,000 acres of overgrazed and eroded reservation ranges to grazing capacity. As a part of their 8-year cooperative agreements with the Soil Conservation Service, the two pueblos reduced stock on their reservations from a total of 86,000 sheep units in 1935 to 23,000 units early in 1940. Reduction to carrying capacity within 5 years was stipulated. But undue hardship to stockmen was avoided by making the change gradually, through several years.

Acoma and Laguna Indians have grazed sheep and goats since the early Spanish conquistadors introduced the animals shortly after 1540. Cattle raising is of more recent advent. Few animals were grazed at first. But livestock improvement, the World War stimulation of wool and lamb prices followed by the post-war slump, the lack of a sound pueblo grazing policy, and an increase in the Indian population, gradually increased the size of herds until reservation ranges became overstocked.

Conducive to overstocking was the Indian conception of wealth, a conception similar to that prevalent until recently among all western stockmen. Numbers were valued above quality. Many useless animals contributed to a gradual destruction of the pueblos' chief resource, the land. In addition, range practices remained unchanged, culling was neglected, and distinctions between livestock grades went unrecognized.

The Soil Conservation Service estimates that pueblo reservations have been overgrazed at least 25 or 30 years. Before overgrazing began, 8 or 10 acres were enough to support a ewe, but today as a result of range depletion and erosion 16 to 25 acres are needed.

As herds and flocks expanded, the valleys lost their thick, stabilizing cover of sacaton grass. From valley to mesa top, browse thinned out. Without the protective covering of grass, soil was washed by unhampered run-off. Gullies cut back up the valleys and lowered the water table. Nowhere else in the Southwest was there a more soil-impoverished area. Before the Indians realized the condition of their ranges they were faced with a serious shortage of forage. The future of their basic livestock industry, and perhaps of their centuries-old villages, depended upon renewing the productivity of the land.

Midway in 1935, the Soil Conservation Service, collaborating with the Indian Service, held meetings with Acoma and Laguna tribal councils and livestock men to discuss a program to stabilize their range and livestock industry. Details were worked out and an 8-year cooperative agreement was achieved between each pueblo as a community, the Soil Conservation Service and the Indian Service. Under administration of the Indian Service, a start was made toward formulating land-use plans designed to rehabilitate the land and stabilize the livestock industry. Efforts of the two agencies were coordinated through a liaison officer appointed to carry out the joint plans.

Both pueblos, through their governors and councils, agreed to the livestock adjustment program voluntarily. A few of the larger owners were at first opposed, but finally agreed upon realization that the cooperation of all stockmen was necessary for the successful launching of the program, with its range improvement benefits and incidental wage work. The objectives of the livestock adjustment program were to save pueblo lands and livestock, and to foster in the Indians a sense of responsibility for the maintenance and betterment of their livestock industry.

Detailed range surveys of the land resources revealed that on the reservation ranges the Laguna stock would have to be reduced to 15,000 sheep units, and Acoma stock to 8,000 units. A tally of livestock on these two ranges in September of 1935 showed Acoma with 31,000 units and Laguna with 55,000 units. Although the Indians were favorably impressed with the general features of the program as presented, it was not easy to convince them that stabilization of the livestock industry depended upon drastic reduction of animal numbers to the estimated carrying capacity of the range.

The 238,000-acre Laguna and 150,000-acre Acoma reservation ranges support livestock which constitute the main livelihood of 2,300 Laguna and 1,200 Acoma Indians. Some means of supplementing the income from surplus livestock during the interim of range recovery had to be found to keep from completely upsetting the economic balance of these people. To lessen the hardship arising from a heavy reduction of

[1] Unit conservationist, Middle Rio Grande area, Soil Conservation Service, Southwest Region, Albuquerque, N. Mex.

Newborn lambs rest in the shade of cholla cactus at midday. Laguna sheep in the Antonio Sedillo Grant purchase area, where Indian stockmen are getting 100-percent lamb crops by following proper grazing practices—almost double the crops prior to 1935.

livestock units, additional range was provided. Government land-purchase range areas were made available through the efforts of the Indian Service to permit the Laguna Indians a total ownership of 21,686 sheep units, and the Acoma Indians a total ownership of 15,756 units. Of the 63,000 sheep units that were cut from the reservations, 14,452 were transferred to the purchase areas, leaving a total reduction in livestock ownership of 48,548 units.

Actually, the pueblos' livestock industry was not so seriously affected by reduction as was expected. As time came for each year's cut, the quota was largely filled by unproductive horses, burros, aged steers, and goats. The first appreciable reduction of strictly good producing classes was during the last cut in early 1940.

While stock adjustment is the leading phase of the range program, season of use, development of stock water, proper distribution, and proper class of livestock are also important. In addition to livestock reduction and improved range and livestock management practices, some badly needed reseeding, fencing, structural treatment, and other erosion control work was done. This work was carried out by the two governmental agencies and was accompanied by a supplementary program of livestock improvement.

Through Indian Service appropriations, money was made available to purchase registered bulls to serve the cattle on both pueblos. These bulls were introduced in 1935. Registered rams to serve approximately one-half the ewe bands were introduced in 1937. Prior to 1935 a few purebred rams and bulls had been imported, with limited success.

One of the most important changes in the livestock industry was the introduction of the cooperative plan of marketing. Livestock and wool are pooled, classified, advertised, and sold by auction to the highest bidders. Some $350,000 worth of livestock and wool have been so disposed of in the 5 years, at more than a 10-percent increase in price. Better shearing methods were introduced.

The large numbers of owners involved—250 at Laguna and 175 at Acoma—makes the future of the program dependent upon full cooperation in carrying out the original plan. It is expected that consistent improvement in quality, intensive culling, and careful selection of replacement animals will help the Indians to make about as much money as they made from the tame ranges in the overstocked area prior to 1935.

As a part of the conservation program, the governmental agencies have continuously carried on an educational program with the Indians to give them an understanding of the range problems, of range management, and of supplementary practices. Basically, the aim was to show the Indians how to maintain and increase their incomes from the land. Results from proper range and livestock management on the government purchase areas have served as an effective demonstration to the livestock owners of these two pueblos. In 1935 when purchase areas were made available to the Indians, they were stocked according to their estimated grazing capacities, and good range management practices followed.

Actual use records show a 20-percent increase in weight of lambs and a 50-percent rise in number of lambs raised. Wool production jumped 20 percent. Calf crops rose 30 percent and calf weights increased 20 percent. Production has fluctuated much less from year to year on the properly stocked and managed ranges than on the overstocked ranges.

Lambs from these flocks were favored in 1937 by the Kansas Agricultural College Experiment Station at Garden City, Kans. About 500 head from the Acoma and Laguna flocks were placed in an experimental feed lot. When purchased by a packer at the end of the feeding period, 75 percent of the carcasses graded premium, as against a 40-percent premium grade on other fed Western lambs for that season. They topped the packer market for the day on which they were sold.

THE COLLECTION AND PROCESSING OF BUFFALO-GRASS SEED

BY DENNIS E. GRIFFITH [1]

THE development of easy, economical methods of collecting and processing the seed of buffalo grass, *Buchloe dactyloides*, has in recent years greatly simplified the problem of establishing this species in adapted areas of the Western Gulf Region.[2] Previously the grass has not been widely established on new areas because of the so-called scarcity and high cost of seed and the expense of establishing it by sodding.

In 1936 it was decided that buffalo grass could play an important part in the erosion-control program by stabilizing eroded cultivated areas converted to other uses such as pastures, terrace outlets and waterways, and in improving old pastures. With this in view the Soil Conservation Service nursery at San Antonio, Tex., undertook to collect seed to supply cooperators in project and camp demonstration areas.

Seed was first collected by C. C. C. enrollees in established buffalo-grass pastures that had been closely grazed. Ordinary house brooms, with 6 inches of the straw cut off to lessen flexibility, were first used. Later, push-type stable brooms were used, greatly increasing the amount of seed material that could be collected by each man. The material was swept into shop-made dustpans, poured into burlap bags, and hauled to the nursery to be cleaned. Under average working conditions each enrollee was able to collect about 20 pounds of material an hour. When cleaned, this 20 pounds of seed material provided about two pounds of cleaned seed with a purity of less than 50 percent.

During the spring of 1937 a total of 468 pounds of cleaned seed was collected in this manner, an estimated yield of 100 pounds per acre. Considering all expenses incident to the collecting and cleaning operations, the cost was 66 cents for each pound.

During the same year the nursery staff developed and constructed a vacuum-type harvesting machine for large-scale collection of seed material. This machine consists of a 30-inch intake fan driven by a 30-horse-power motor. Galvanized pipes lead from the intake opening to the ground, terminating in three nozzles, each of which is 22 inches long with an opening approximately one inch wide. Cross bars of welding steel are spaced at intervals across each nozzle to prevent large rocks and other bulky material from entering the pipes. The seed material is blown through the fan into a box where it passes over two slanting screens, the refined material being deposited in a burlap bag. The machine is mounted on a 1½-ton truck. It operates satisfactorily on closely grazed pastures where there are not many stumps and rocks.

It has been found that the cost per pound of cleaned seed is approximately the same for hand-swept and machine-harvested material.

During the fiscal years 1938 and 1939 a total of 20,513 pounds of cleaned buffalo-grass seed was harvested. Of this amount, 14,780 pounds were collected by enrollees in C. C. C. camps in central Texas, and the remainder with the machine. More than 11,531 pounds of cleaned seed was harvested during the summer and fall of 1938, and nearly 12,000 pounds during the summer and fall of 1939.

Although the cost of collecting by hand was 66 cents per pound early in 1937 and 33 cents in the fall of the same year, by autumn of 1938 and 1939 it had dropped to 15 and 24.4 cents per pound respectively. This reduction was due to the increased efficiency of the collectors, accessibility of collecting areas, and improved cleaning methods. Nearly 2,500 pounds of cleanings were not figured in the 1939 totals, although the material was distributed as seed. If these cleanings had been figured, the cost per pound would have been reduced to 20 cents.

The following tabulation presents a summary of buffalo-grass seed collecting activities for 1938, 1939, and 1940:

Fiscal year	Amount of seed collected	Cost per pound, clean seed	Average yield per acre	Percent of purity	Percent of germination
	Pounds	*Dollars*	*Pounds*	*Percent*	*Percent*
1938	8,971	$0.327	125	29.18	67.12
1939	11,531	.146	90	41.70	58.76
1940	*9,257	.244	100	41.52	65.64

*2,499 pounds of cleanings not included.

It will be noted that the purity figures for 1939 and 1940 are much higher than those for 1938. This difference is explained by the fact that better cleaning methods were used.

[1] Manager, Soil Conservation Service Nursery, San Antonio, Tex.

[2] See articles by Guy C. Fuller in SOIL CONSERVATION: Developing Machinery for Harvesting Buffalo-Grass Seed, Jan. 1936; Machinery That Facilitates the Harvesting of Grass Seed, Dec. 1935; A Close-Up of Buffalo Grass, Native of the Great Plains, Sept. 1936.

Several methods of cleaning not used in 1938 were tried in 1939 and 1940. In 1938 the grain thresher and fanning mill were used. In 1939 a higher purity was obtained by pouring the seed material into a vat of water and floating off the good seed and some light trash. The floated material was dried by running it through a fanning mill. This operation was successful but expensive as much time was consumed in the drying process.

In September 1939 (fiscal year 1940) the nursery purchased a 40-inch all-crop seed harvester, or combine. After adjustments were made this machine greatly reduced the cost of cleaning. The tabulation-weighted averages do not bring out the difference in costs.

Plans are now being made to use a hammer mill to grind the lumps of dirt, soft rocks, sticks, and other foreign material before it is put through a cleaning machine. By adjusting the cleaning machine, we expect to obtain seed of 75-percent purity.

In most cleaning operations a large number of seed "burs" were broken up and the naked caryopses deposited with the dirt and fine stones. In one instance the percentage of such caryopses ran as high as 2.66. These screenings are not wasted, but instead are distributed as seed.

For the farmer or rancher the most practical and economical method of collecting buffalo-grass seed is to sweep the seed material with brooms from closely grazed pastures, sack it and spread it on new areas without cleaning. Often a plentiful supply of this material may be obtained at low cost by sweeping up the riffles of trash and seed from wherever they may be deposited after a heavy rain. Running water will lift the seeds off the ground, carry them down the slope, and either deposit them in a stream or in riffles at the base of the slope. It has been found that seed material of this kind can be planted successfully with a cotton planter after it has been screened through one-fourth-inch mesh hardware cloth.

Plans have been made in the Western Gulf Region to harvest 20,000 pounds of cleaned buffalo-grass seed during the summer and fall of 1940, and it is believed that the experience gained during the past 3 years will make it possible to obtain seed of high quality at a comparatively low cost.

EDUCATION IN DISTRICT OPERATION

By F. S. EDMISTON [1]

THE adoption and execution of the soil conservation districts program and work plan in Louisiana was preceded by an educational program that greatly facilitated progress of the work. Conservation practices such as terracing and contour cultivation have been stressed for a number of years by the Agricultural Extension Service. The large-scale demonstrations in concentrated areas as carried out by the 6 Soil Conservation Service demonstration projects and by the 11 S. C. S.-C. C. C. camps further proved the value of conservation measures and of the coordinated approach through good land-use, management and soil-conservation practices. Cooperative soil conservation and land-use demonstrations also helped greatly in paving the way for the district program. This, in addition to educational activities in the proposed districts, carried on step by step as they were being created, served to crystalize the desire for organized action—as manifested by the 98.2 percent of the votes in the 12 districts cast in favor of certain of the districts.

Three factors determine to a large degree the speed with which the work plan of a district may be executed. The first is the extent of coordination of activities by agencies assisting the district supervisors, and the second is the extent to which farmers living within the district accept their responsibilities, collectively and individually. The third factor is the amount of assistance available to supervisors. The Soil Conservation Service is now offering assistance to 12 soil conservation districts covering virtually all the land in Louisiana subject to serious erosion.

In order that all cooperating agencies may be fully acquainted with the procedure in the district programs and with the subject matter applicable to the district, training courses or schools should be conducted for the personnel of all agricultural agencies operating within the district, and for a clear understanding of the problems the different agencies should study every phase of the district organization and objectives.

The State Soil Conservation Committee worked in the beginning to inform all State and Federal agricultural agencies in Louisiana as to details of the districts program so that they could determine in what way they could assist with the work. To this end the committee invited representatives of all agencies to attend a joint meeting. At this conference the program was thoroughly explained and copies of work

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plans and programs of representative districts were made available for study. Two weeks later, a 2-day meeting was held by district supervisors and the agency representatives who had attended the preliminary conference. At this meeting the district supervisors were informed as to the contributions available from each, and also the requirements necessary in order to obtain this assistance.

Upon the adoption and approval of the district program and work plan, the supervisors enter into a memorandum of understanding with the United States Department of Agriculture. It is then most important that farmers and landowners be informed regarding the details of their program and work plan, especially with regard to the assistance available through their local supervisor, and the extent of technical assistance, materials, equipment, and C. C. C. camp labor that can be obtained as aid in solving individual land-use and soil-conservation problems. In order to secure group action by landowners, and to make it possible for the technicians to work economically, intensive educational work should be conducted in priority work areas when such areas are set up by the supervisors. Land-use capability maps may be used to good advantage in securing group action of farmers in farm planning and execution of the farm plan.

Most soil conservation practices lend themselves to the conducting of method demonstrations whereby a group may be shown how to establish soil conservation practices most efficiently and economically.

County agents assisted by the extension specialist and soil conservation technicians may encourage, through method demonstrations, the execution of farm plans. Other agency representatives, such as vocational agricultural teachers and workers of the Farm Security Administration and State and Federal forestry services, may help in this respect. Possibly the most important tool for use in getting soil conservation practices established on the land is the soil-building practice payment under the Agricultural Adjustment Administration. The Triple-A payments make it possible for farmers and landowners to receive help in carrying out most of the soil conservation practices established according to specifications, and usually are sufficient to take care of the greater portion of the cash outlay necessary in establishing the practices. For example, the Triple-A will pay farmers at the rate of $1.50 per 200 linear feet of terraces constructed. Terraces must meet specifications set up by the A. A. A. committee and must be provided with suitable outlets. Payments are provided for the establishment of permanent pasture, planting of forest trees, and many other soil-building practices. To stimulate further the carrying out of soil-building practices, the Triple-A will furnish as a grant-of-aid, winter-legume seed and phosphate. With such aid, and that of Soil Conservation Service technicians in the district, farmers will go forward with soil and water conservation on their land.

County agents are in a good position to advise the farmer as to ways and means of taking advantage of the opportunities offered through the districts program, and to encourage widespread application of all soil conservation practices.

Farmers living outside priority work areas should be kept informed as to the progress made, and should be encouraged to establish on their farms as many as possible of the soil-conservation practices requiring no technical assistance, such as growing summer and winter legumes and green manure crops, and protecting crop residue from fire. Cooperative soil-conservation and land-use demonstrations should be established in all communities immediately as an example to all the community of the entire program of good land-use and soil-conservation practices. These demonstrations will create interest within the community and pave the way for active cooperation and participation when assistance is available to these communities. Joint farm planning with cooperating agency representatives will result in better coordination of effort; with all agencies cooperating in the execution of the plans these demonstration farms will show early results.

It is very important to have an active organization of all agency personnel operating within a county. Usually the county agent should be chairman of the county organization. Through this organization it is possible for each agency to be familiar with the other's program, and for the entire group to coordinate all activities into the county agricultural program. With each agency making its maximum contribution, problems as they arise can be met by the group acting as a unit. Agricultural agency organizations have been functioning to good advantage in Louisiana.

It is essential that education and operations go along together; one will stimulate or facilitate the other. The personnel of all agricultural agencies operating in a county should offer their assistance to the district supervisors, in whatever capacity their agency is in a position to serve, in carrying out work plans. The problems and objectives of the districts should be kept before the farmers and the general public, through use of the press, radio, exhibits, tours, and talks before farmers' meetings, civic or other groups.

BOOK REVIEWS AND ABSTRACTS

by Phoebe O'Neall Faris

A VISIT TO THE UNITED STATES OF AMERICA TO STUDY SOIL CONSERVATION. By Colin Maher. Department of Agriculture, Colony and Protectorate of Kenya. Nairobi, Kenya. 1940.

Two years ago last July 24th, Colin Maher arrived in Washington from Kenya to line up an itinerary for a tour of the United States. We remember him well as the "man out of Africa" who knew what he wanted "out of America" almost before he reached our shores. Now, as he reports on his tour specifically for the benefit of Kenya, American conservationists have that rare opportunity, the chance to look at their own work from the point of view of the Chief of a "foreign" Soil Conservation Service. Mr. Maher's discernment as an observer, combined with his critical acumen, has resulted in an extraordinarily clear analysis of the works and objectives—and mistakes—of soil conservation agencies of the United States.

Mr. Maher did a thorough job of observing and studying conservation methods in this country—in 4 months he visited more than 90 projects, experimental stations, and field offices. At home, in Kenya, he had been appointed Agricultural Officer and Experimentalist in Charge of the Soil Conservation Service of the Colony and Protectorate of Kenya, East Africa, with headquarters at Nairobi. He came to America with the idea of making recommendations for a soil-conservation program for Kenya; perhaps he will return at some future time to tell us, in particular, of progress in erosion control on lands occupied by native Africans just beginning to emerge from the pastoral phase of agricultural endeavor.

Mr. Maher's report shows two angles of thought resulting from his American observations: In the first place, he realized most keenly the importance of profiting by rule of error (in this instance, United States Department of Agriculture errors) and, second, his urgent need was for methods, plans, and practices that could be adapted to the peculiar problems of his homeland as inexpensively as possible. In pointing out the difficulties that have been and are being gradually worked out in this country for coordination of effort among many agencies and individuals pushing steadily toward efficiency in the conservation program, Mr. Maher sums up frankly what we all know, only too well, of duplication, bias of opinion, and inadequate foresight in the early days of soil conservation and land utilization programs. Nevertheless, it is apparent that he understands quite thoroughly that he is analyzing the healthy growth and development of an essential and democratic idea in a democratic Nation. Most significant is his conclusion that without doubt "the success of the Soil Conservation Service [in the United States] has been largely due to the continuous personal contact between officials and farmers" and that . . . "nevertheless, the Soil Conservation Service owes a considerable debt to the State Experiment Stations and to ecological botanists . . . and to other bureaux and agencies of the Department of Agriculture for the supply of information on agronomic matters, economics and other branches of agricultural science, which could be utilized in devising the soil conservation programmes in the various project areas." It is not difficult for those of us who became acquainted with Mr. Maher when he was in America to imagine him, back home in Kenya, walking over Kenya's soils by day, and by lamplight pouring over voluminous notes from America in the determined effort to choose for Kenya the best out of the whole of conservation methods, practices and organization. It is to be hoped that the writing of this report of his visit to America helped him in separating detail, and in choosing and discarding means and methods for recommendation to Department of Agriculture officials at Nairobi.

Before beginning his report on what he saw two years ago in the United States, Mr. Maher states for the benefit of both this country and Kenya, that constructive criticism of soil conservation methods and policies would be welcomed, in fact was invited, by our Service. He therefore forthrightly criticizes, without mincing of words, many of the past and present (two years ago) policies and practices having to do with the use of land in the United States. His report shows that he was appalled at the results of land exploitation and farm family conditions in many of the areas through which he traveled, so that it was at times difficult for him to observe with enthusiasm the soil conservation demonstrations in scattered locations. Erosion losses of the East are emphasized, as are ecological changes of the Middle West under intensive plowing and cropping. Overgrazing of the ranges of the Southwest, difficulties in reducing livestock numbers, and costs of strip sodding, terracing and other conservation practices receive more emphasis than do the rapidly expanding areas where soil and water conservation was at that time and is today being carried out with notable success. To those of us who are in touch with the 1940 Soil Conservation Service of the United States it is consoling to know that while Mr. Maher's criticisms probably were justified two years ago, today these ills of error and over-enthusiasm are being rapidly healed by ever closer coordination of planning and work-out of plans.

In his description and appraisal of conservation achievements as he saw them throughout the various regions of this country, Mr. Maher emphasizes erosion conditions and aleviating measures by the brief outline method: Often a single sentence serves to summarize results of many months of planning and work. Such sentences are extraordinarily well chosen, however, and there is not one that does not point out an important feature, result or objective of the United States program to conserve United States soils. Projects and methods of the Southwest interested Mr. Maher in particular, judging from his report, the reason for this being, no doubt, the certain similarities as to climate, soils, topography and grazing conditions between the area and Kenya. It is obvious throughout the whole of the report that while visiting in America, Mr. Maher had foremost in his mind one picture, one thought—Kenya, and what he hoped to find in America that could be turned to good account for Kenya. For that reason his description of projects may seem somewhat sketchy from our point of view, while at the same time we have an opportunity for comparison, country-wide in scope, rarely accorded us by our own writers. Most soil conservationists will be greatly interested in Mr. Maher's impressions from this viewpoint in particular.

In his role as experimentalist, Mr. Maher visited six experiment stations in this country. He reports rather briefly on hydrologic investigations, run-off and soil losses as related to terracing, grazing

BOOK REVIEWS AND ABSTRACTS

continued

trials on range covers, control of flood flow from steep slopes, and studies of balks in row crops.

In making special studies of the Civilian Conservation Corps and some of the settlement projects of the United States, Mr. Maher apparently found many things of special interest to him. He strongly recommends a C. C. C. for Kenya, as an aid in soil conservation efforts; he is enthusiastic about settlement schemes designed toward the ideal of the self-sufficient farmer. He reviews the educational program of our Service with clarity and urges that a soil conservation education officer be appointed for his own East African country.

Exceedingly interesting is that part of his report which gives some insight into recommendations and plans for conservation of the soils of Kenya. To begin with, he expresses himself as follows: "A visit to the U. S. A. reveals * * * that parallels can be drawn, allowance being made for a difference in scale, between every agricultural or social feature leading towards soil erosion in Kenya Colony and in the United States." One is to infer, therefore, that in his opinion curative policies and procedures for Kenya's soils may be safely based on land utilization and soil conservation policies and procedures already begun in the United States at the time of his visit. Mr. Maher explains the need for surveys, of soils, water supplies, grassland resources, human and sociological conditions, for use in making regulations regarding land use in Kenya. He points out the native system of land tenure as a problem requiring much consideration and circumspect handling in order to avoid agricultural indebtedness and "excess of the human carrying capacity of the land."

As to soil conservation methods for Kenya, provided the land-tenure and farm-size problems can be regulated, these should not be too difficult to apply since the land of the small country has not as yet been greatly exploited through over cultivation by mechanical means. Mr. Maher hopes that it will not be necessary to subsidize farmers to assist them to terrace their lands; he does recommend, however, that where terraces are necessary technical assistance be provided as under the districts organization in Southern Rhodesia and the United States. He recommends also that Kenya natives be trained as technical advisors and that simple conservation methods be introduced among native farmers as soon as possible. Contour banks, live wash-stops, regrassing and introduction of browse plants, kudzu for gully control, lespedeza for soil improvement and for hay—these are some of the soil conservation methods pointed out as important in the earlier stages of the program. Above all, as Mr. Maher wisely points out, "confidence of the natives in the soil control and land improvement work must not be forfeited through the break-down of bank or bench terraces, or of dams, which have suffered from lack of supervision in maintenance."

Finally, at the close of his report, Mr. Maher expresses his warm appreciation to "all who rendered possible my visit to the United States and to all my friends in that vast country who made my visit so liberal an education, so pleasantly acquired."

WHAT IS ECOLOGICAL THINKING?

Some years ago a farmer in New York State was complaining to a friend that there were no longer any ducks on the big marsh at the lower end of his farm.

"Herb," he said, "you're a biologist, can't you tell me why I haven't any ducks anymore? There used to be three or four broods come off that marsh every summer."

"Well, John, I don't know. It might be for any one of a dozen reasons. Let's walk down that way and take a look."

But it was not settled in one afternoon. Herb made several visits to the marsh at different seasons of the year until, bit by bit, he pieced his observations together to make a complete picture. Then the biologist met his friend again.

"The ducks are gone," he said, "because the boys are trapping all the skunks."

"Why, what in thunder have the skunks got to do with the ducks?" John retorted, "I'd think trapping the skunks was all to the good, if you ask me."

"Maybe so," continued Herb, "but the situation looks like this. Skunks dig snapping turtle eggs out of the sand where they're laid, and eat them. When the fur prices went up and the boys started trapping skunks the turtles has a chance to multiply. But there wasn't enough food down there for them and they began to feed on the ducklings. Ducks won't nest where they are molested that way, and so they have gone somewhere else. If you want those ducks back you'll have to quit trapping the skunks. Their hides aren't worth much now anyway."

John was not convinced, but the ducks had been the pride of the whole family, so he decided to try the biologist's suggestion. Today there are as many ducks as ever. For when trapping ceased, the skunk population increased with a resultant drop in the number of snapping turtles; the turtles no longer exerted pressure on the ducks, which returned to nest at the pond; and something like the previous set of relationships was established.

The biologist had attempted in this instance to deal with all the factors affecting a given situation, instead of considering a single factor to the exclusion of others that might have an equally important influence. This is an example of ecological thinking.—Edward H. Graham.

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